# Measurement of the cross section of (p,$^3$H) reactions in $^{46}$Ti, $^{58}$Ni and $^{90}$Zr

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We have determined the cross section of the reactions $^{46}$Ti(p,$^3$H)$^{44}$Ti, $Q = -14.238$ MeV and $T_{1/2} = 62.3(5)$ y; $^{58}$Ni(p,$^3$H)$^{56}$Ni, $Q = -13.984$ MeV and $T_{1/2} = 6.10(2)$ d; $^{90}$Zr(p,$^3$H)$^{88}$Zr, $Q = -12.805$ MeV and $T_{1/2} = 83.4(3)$ d, for energies up to 30 MeV.

The experimental method used had consisted in the measurement of the residual activities of the reaction products by the simple gamma spectroscopy, following, when necessary, the decay of the half-life. Characteristics gamma-rays and half-lifes allows an unambiguous determination of the related activities. Parameters like target thickness, beam energy and current, were carefully determined due to the fast variation of the cross section in the energy interval considered.

The irradiations were performed at the Cyclone-30 cyclotron of the Institute for Nuclear and Energetic Research (IPEN). The targets were settled in the usual way of stacked-foils, with thin foils of natural Ti, Ni and Zr plus sheets of Al for energy degradation. On each targets, two thin foils of Cu were placed for beam energy and current monitoration. The gamma spectra were acquired with a HPGe germanium detector with energy resolution better than 1.69 keV for the 1332 keV transition of $^{60}$Co. Special attention was paid to the detector energy and efficiency calibration.

The cross section values obtained were compared with published values of other authors. Also, theoretical calculation with well known theoretical model including equilibrium and pre-equilibrium emissions were done to test the capability of these models to predict experimental results in the energy range and reaction considered such as their usefulness for new experimental design.

All the studied reactions have great astrophysical interest. All results were consistent with the previous known data, and contributes to fill an energy region (near the reaction threshold) where it is noticeable the scarce data in many cases, in spite of been relatively very well known reactions at higher energies.

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